Asymmetry of matter and antimatter.

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To be honest, I'm not sure that there is a matter-antimatter asymmetry in the Universe.

At first glance, it seems to us that the world we observe is made of matter, and there is almost no antimatter. But maybe we just think...

In fact, our observable world, like the entire Universe, is created from matter and antimatter, and in a strict ratio of 50 : 50. This is logically derived from the point structure of elementary particles. For further consideration, we read very carefully the quote from the textbook [1]:

“...The impossibility of the existence of absolutely rigid bodies can be convinced in another way. Let some solid body be set in motion by an external action at some point of it. If the body were absolutely solid, then all its points would have to move simultaneously with the one that was affected; otherwise, the body would be deformed. The theory of relativity, however, makes this impossible, since the impact from a given point to the rest is transmitted at a finite speed, and therefore all points of the body cannot simultaneously begin to move.

From what has been said, certain conclusions follow regarding the consideration of elementary particles, that is, particles for which we believe that their mechanical state is fully described by specifying three coordinates and three components of the speed of movement as a whole.

Obviously, if an elementary particle had finite dimensions, that is, would be extended, then it could not deform, since the concept of deformation is associated with the possibility of independent movement of individual parts of the body. But, as we have just seen, the theory of relativity shows the impossibility of the existence of absolutely rigid bodies.

Thus, in classical (non-quantum) relativistic mechanics, particles that we consider as elementary cannot be ascribed to finite sizes. In other words, within the limits of the classical theory, elementary particles should be considered as point...”.

It is obvious that from the point structure of particles (the linear dimensions of an elementary particle are equal to zero) it strictly follows that the particle cannot be deformed, and hence the fundamental impossibility of its destruction.

Therefore, such a particle is, by definition, the most stable particle in the Universe, and cannot be destroyed in any way. That is why such a particle is called elementary and is structureless in its essence.

That is, an elementary particle is a stable point particle that cannot decay.

Now let's remember that there are not so many stable elementary (point) particles - these are the electron, positron, photon and neutrino/antineutrino (electron neutrino, muon neutrino and tau neutrino; it is not known whether the neutrino has an antiparticle). In other words, it is a photon, an electron and a neutrino and their antiparticles.

So, we have such stable point elementary particles:

1. Electron.

2. Positron.

3. Photon.

4. Neutrino/antineutrino (electronic, muon and tau neutrino).

Moreover, only the electron and the positron have a charge. All particles have mass, except for the photon. Also, all particles except the photon are fermions.

Based on the presence of a charge, it is quite obvious from which elementary particles the proton, neutron and all baryons will be built - of course, exactly from an electron, positron and photon (a boson is always needed to transfer the interaction), the participation of a neutrino/antineutrino is also possible, which can cause radioactive decay (oscillations).

Taking into account the theory of relativity and the mass defect, the formation of compound particles from an electron, a positron, a photon and a neutrino/antineutrino can be represented in the same way as described in the work “The radius of the electron and the mass of compound particles like the proton and neutron” [2] .

That is, a composite particle is formed by increasing the mass (relativistic) of elementary particles, and the “mass gain” goes into radiation/carrier boson, and remains inside the particle.

Then, interaction carriers (bosons), such as gluons, can be considered as “internal radiation” from a mass defect or in a certain way “weighted” photons (due to momentum transfer). A photon is already moving at the speed of light, therefore, it can only increase its energy/energy density by transferring momentum (a particle that has a rest mass increases its kinetic energy with increasing speed, which can be radiated or transferred to another particle). Naturally, bosons consisting of fermions can also be observed.

Composite fermions can be considered as particles consisting of an electron, or a positron, or a neutrino/antineutrino, or combinations thereof, and a photon, which, due to a (relativistic) mass defect, form a composite particle.

You can ask the question: how then to explain the fractional charge of quarks (if they consist of, or are formed from, an electron, a positron, a photon, etc.)?

This question does not refute, but confirms the above model. I'll quote [3]:

“...How to check that the charge of quarks is really fractional? The quark model predicted that during the annihilation of a high-energy electron and positron, not hadrons themselves would be born, but first quark-antiquark pairs, which then turn into hadrons. The result of calculating the flow of such a process directly depended on the charge of the produced quarks. The experiment fully confirmed these predictions...”.

That is, high-energy, read relativistic electrons and positrons, will inevitably lead to the birth of quarks/antiquarks (in a collision), and then hadrons. Therefore, it is logical to assume, taking into account the energy balance, that relativistic electrons and positrons, when colliding inside particles, will give rise to baryons. Obtaining baryons is possible immediately as a result of the collision of elementary particles, or, after the formation of quark-antiquark pairs, “extra” antiquarks will “leave” the particle in the form of various radiation.

Thus, we were convinced that there is no asymmetry of matter-antimatter in the Universe. Since the number of pluses (positrons) is exactly equal to the number of minuses (electrons).

The reason for the baryon asymmetry in the observable Universe is a consequence of the assembly of protons, neutrons, atoms and other composite particles from elementary particles of matter and antimatter. That's all.

And most importantly: is it possible to test experimentally the stated model of the structure of nucleons and nuclei, after all, physics is an experimental science?

Without any doubt! For experimental verification of the model, it is sufficient to synthesize an artificial proton and neutron, of course, from the corresponding number of electrons and positrons.

For the synthesis of a proton, we organize a high-energy three-particle collision between 2 positrons and 1 electron (the kinetic energy of the positrons and the electron must be higher than the rest energy of the proton). The result must inevitably be a synthetic proton. To create a neutron, you need to arrange a high-energy four-particle collision between 2 positrons and 2 electrons.

In the end, I will add that the conservation of the baryon/quark number is a purely empirical law that does not follow from any fundamental laws of nature. Therefore, there are no strict theoretical prohibitions on the synthesis of baryons from leptons (although such processes are not currently known).

1. Landau L. D., Lifshits E. M. Theoretical physics. Volume 2. Theory of the field. Moscow: Nauka, 1988. P. 68 – 69.

2. Bezverkhniy V. D. The Radius of the Electron and the Mass of Compound Particles Like the Proton and Neutron. SSRN Electronic Journal, 10 Jan 2023, pp. 4 – 5. https://dx.doi.org/10.2139/ssrn.4320226

3. Quark. Wikipedia (ru). https://en.wikipedia.org/wiki/Quark